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numbers near the numerals I., II., etc., indicate the Jovian perturbation of the comet's mean anomaly in the revolution following that passage. It will at once be seen that the figure opposite V. is abnormally large, although the approach to Jupiter was less close than for passage III. This increases the suspicion that the perturbations for the present revolution may be too large; indeed, in the case of the perturbation in eccentricity the suspicion rises almost to a certainty.

I do not know whether Pontécoulant's calculations are still in existence; the article in *Comptes Rendus*, vol. lviii., does not mention where they are to be found. Assuming that they are still in existence, a careful re-examination of all the figures might suffice instead of an entirely independent computation of the perturbations. For there is no question whatever of Pontécoulant's ability, merely a suspicion of possible numerical slips. The inconsistency that I have adduced above is of itself sufficient to demand such a re-examination, before the results can be received with confidence. One can hardly imagine a greater loss of prestige to astronomy than that which would arise if there were a notable error in the prediction of this return of the comet, after the wonderful success achieved in 1759 and 1835.

Assuming that the date 1910 May is correct for the perihelion passage, I think the complete failure of the Ångström curve is not without a warning to us. We have here a curve which admirably fits 25 successive passages, and yet the first time it is used to predict a return it breaks down utterly, the error being almost 3 years, or three times the largest previous error. This is a decidedly startling fact, and indicates the danger of using terms of an empirical nature in lunar or planetary tables. Where such are used, it is at least desirable that means should be provided for readily effecting their removal from the calculated positions.

The Proper Motion of Castor. By A. C. D. Crommelin.

In the determinations that have hitherto been made of the proper motion of Castor, it does not appear that any effort has been made to separate true proper motion from orbital motion; the values given have merely been deduced from the meridian observations of the principal star, from the time of Bradley to the present day, on the assumption of uniform rectilinear motion. This assumption was fairly justifiable for the 130 years from 1755 to 1885, during which the curvature of the orbital path was slight; it is now rapidly increasing, so that the orbital motion in 1906 is at right angles to that in 1820, and in a few years the accepted proper motion will become entirely erroneous. There is as yet scarcely a long enough arc covered by the meridian observations to make a reliable determination of the relative masses from them. An attempt is made by Mr Lewis and Mr Furner in

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the recently published Memoir on the Struve Double Stars (vol. lvi. p. 215); but while the collection of meridian observations and their reduction to a common epoch is of great interest and value, it seems to me that their determination of the mass-ratio (brighter star 20 times the fainter) is vitiated by the implicit assumption that Auwers' proper motion may be taken as the true proper motion of the centre of gravity of the system. I believe that it is the apparent resultant motion of the brighter star, and consequently it is only to be expected that its application should bring this star to relative rest. The inference that the brighter star is far the more massive I consider unsound. I had reached this conclusion before I saw the discussion of this system from spectroscopic observations by Dr Heber D. Curtis in *Lick Observatory Bulletin* No. 98. On the assumption that the two minor systems (each star being a spectroscopic binary) are coplanar with the major system, he reaches the conclusion that the mass of α_1 (the fainter component) is 6 times that of α_2. The assumption is of course tentative, but the resulting mass-ratio is probably more reliable than any that can be at present obtained from the meridian observations. I decided to adopt it as a trial hypothesis, and to see how it would work. Using the Greenwich observations collected on p. 215 of the Struve Memoir, the position of the centre of gravity reduced to 1890 with Auwers' proper motions and corrections, comes out as follows :—

Epoch of Catalogue.	Position of Centre of Gravity on the above Assumption of Masses.					
	R. A.			N.P.D.		
	h	m	s	°	′	″
1840	7	27	....	57	52	16·99
1845			34·459			16·51
1850			34·544			16·99
1860			34·520			17·35
1864			34·491			16·86
1872			34·490			17·90
1880			34·547			17·91
1890			34·601			18·87
1900			34·566			18·57

From these I deduce a correction to the assumed proper motion of

	s	″
	+·0016	+·041
Auwers' value is	−·0151	+·079
Newcomb's being	−·0144	+·082

Hence the concluded proper motion of the centre of gravity of the system is $-{}^{s}{\cdot}0135$, $+{}^{\prime\prime}{\cdot}120$.

If the above mass-ratio is correct, we should expect a much more definite curvature in the position of α_2 than of α_1. It is

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fortunate that this is the case, as observations of α_2 are much more numerous. I have accordingly reduced the following observations of α_2 to 1890, with the proper motion $-{}^{s}{\cdot}0135$, $+{}''{\cdot}120$.

Positions of α_2 *reduced to* 1890.

		h	m	s	°	′	″	
Bradley .	1757	7	27	34·88	57	52	21·64	Adopt $34^{s}{\cdot}83$ $21''{\cdot}6$
T. Mayer .	1757			34·74			21·54	
Piazzi .	1800			34·84			17·8	
Greenwich	1840			34·99			17·78	
,,	1845			34·94			17·24	
,,	1850			34·93			16·86	
,,	1860			34·93			16·43	
,,	1864			34·90			15·86	
,,	1872			34·88			15·73	
,,	1880			34·91			15·60	
,,	1890			34·91			15·45	
,,	1900			34·82			14·93	

These have been plotted on the diagram; it will be seen at once that, omitting Piazzi, which is discordant, they do indicate a curvature of about the required amount, as compared with Mr Lewis' diagram of the orbit. Hence they support the adopted mass-ratio as at least approximately correct. Obviously no curvature would be shown if α_2 had much the greater mass.

As Castor is a Greenwich clock star, it would seem to be advisable to follow the method that has already been adopted for Procyon, viz. to apply a double correction, one for the proper motion of the centre of gravity, the other for orbital motion round this point.

For example, in reducing the 1890 place of Castor to 1920 we should have to apply $-{}^{s}{\cdot}0135 \times 30 - {}^{s}{\cdot}11$ to the R.A., and $+{}''{\cdot}120 \times 30 - {}''{\cdot}56$ to the N.P.D. (in addition to precession). The second term is the orbital correction deduced from Mr Lewis' diagram on the assumption of mass-ratio 1 to 6.

These amount to

$$-{}^{s}{\cdot}405 - {}^{s}{\cdot}11 = -{}^{s}{\cdot}515$$
$$+3''{\cdot}60 - {}''{\cdot}56 = +3''{\cdot}04$$

whereas if Auwers' proper motion were used they would be

$$-{}^{s}{\cdot}0151 \times 30\,,\quad +{}''{\cdot}079 \times 30 \quad = -{}^{s}{\cdot}453\,,\quad +2''{\cdot}37$$

Hence even now the effect of the correction is sensible, and it will rapidly increase as periastron is approached. The direction of orbital motion in N.P.D. will be reversed in a few years, after which Auwers' and Newcomb's values of the motion in N.P.D. will become altogether erroneous.

This is, I believe, the first occasion when spectroscopic obser-

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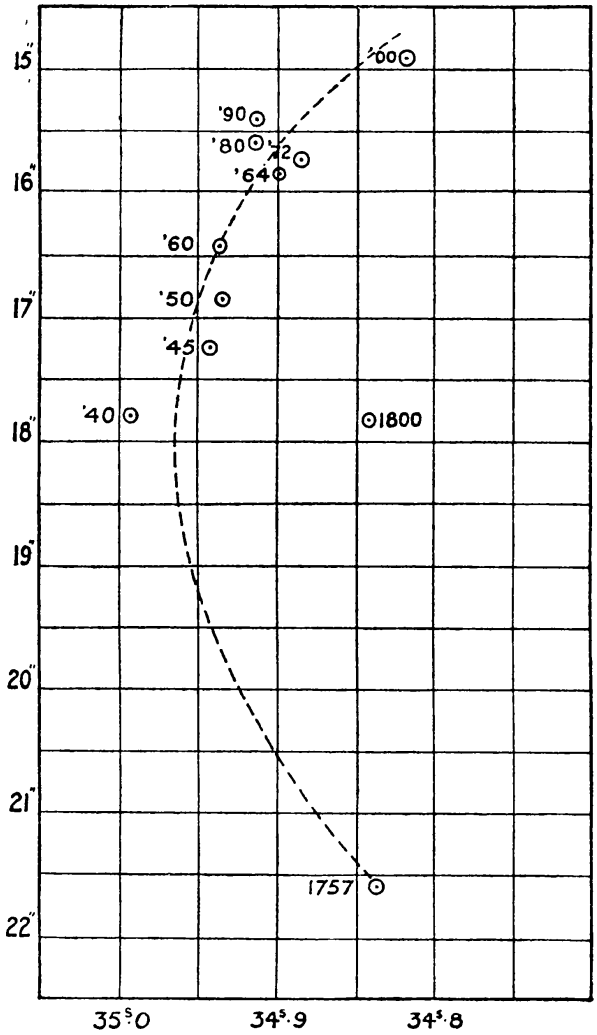
vations have assisted in determining the proper motion of a star. The possibility of mutual assistance of this kind forms another link connecting physical astronomy with astronomy of position.

Perhaps it is as well to call attention to an erratum in Mr Lewis' Memoir which misled me for a time and may mislead others. On p. 21 Mr Furner's determination is printed as though the fainter star had 20 times the mass of the brighter. His determination on p. 215 of the Memoir made the bright star 20 times the faint, and, although the reverse is probably true, the two pages should be made consistent.



Meridian Observations of α_2 Geminorum (Castor) reduced to 1890, with Proper Motion $-^{s}\cdot0135$, $+''\cdot120$.

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Estimate of the Number of Stars within Certain Limits of Proper Motion. By W. G. Thackeray.

The following data are derived from discussions of statistics of proper motions, published (1) by Prof. Auwers in the introduction of the Berlin "A" Catalogue of the Astronomische Gesellschaft series, pp. 141–143, where he discusses the Bradley proper motion referred to here as "Bradley," as well as certain of his zone stars referred to here as "Auwers," and though the separation of the stars is not in all cases identical with the grouping adopted in this paper, it is quite near enough for the purposes of this paper; (2) by Prof. Dyson and myself in the introduction to the New Reduction of Groombridge's Catalogue, p. xcii; and (3) by myself on some Carrington proper motions, published in the present volume of the *Monthly Notices.* The Bradley observations extend over the northern sky, Groombridge's lie within 52° of the pole, Carrington's within only 9°, and the Berlin "A" series are within the zone of +15° to +20° of Declination. The material under discussion cannot be considered to extend beyond 9·4 magnitude stars, but from the results it would appear as though the adopted percentages might be used further without much risk of appreciable error.

The agreement between the different catalogues is especially good for the fainter stars, and suggests the absence of any serious systematic error.

Percentage of Stars within Certain Limits of Centennial Proper Motions.

Authority.	0″ – 5″	5″ – 10″	10″ – 20″	>20″	No. of Stars.
	Magnitude 1–4·9.				
Bradley . . .	42	22	18	18	711
Groombridge .	45	21	20	14	234
	43	22	18	17	
	Magnitude 5·0–5·9.				
Bradley . .	49	26	16	9	951
Groombridge .	59	21	14	6	538
	55	23	15	7	
	Magnitude 6·0–6·9.				
Bradley . .	52	29	13	6	1367
Groombridge .	66½	21	8	4½	1149
	60	25	10	5	